TRANSACTIONS

OF THE

AMERICAN INSTITUTE

OF

ELECTRICAL ENGINEERS,

VOL. XI.

MEETINGS OF

JANUARY 17th, 1894.
FEBRUARY 21st, 1894.
MARCH 21st, 1894.
APRIL 18th, 1894.
SEPTEMBER 19th, 1894.
OCTOBER 17th, 1894.
NOVEMBER 21st, 1894.
DECEMBER 19th, 1894.

MAY 15th, 16th, 17th and 18th, 1894.

(Copyright, 1894.)

PUBLISHED BY THE INSTITUTE,

AT ITS OFFICE, 26 CORTLANDT STREET.

NEW YORK CITY, U. S. A.

OFFICERS AND MEMBERS OF THE COUNCIL.

1894-95.

PRESIDENT:

PROF. EDWIN J. HOUSTON,
Term expires 1895.

PAST-PRESIDENTS:

DR. NORVIN GREEN, 1884-5-6.
FRANKLIN L. POPE, 1886-7.
T. COMMERFORD MARTIN, 1887-8.
EDWARD WESTON, 1888-9.
PROF. ELIHU THOMSON, 1889-90.
PROF. W. A. ANTHONY, 1890-91.
ALEX. GRAHAM BELL, 1891-2.
FRANK J. SPRAGUE, 1892-93.

VICE-PRESIDENTS:

Terms expire 1895.
PATRICK B. DELANY,
H. WARD LEONARD,
WILLIAM WALLACE.

Terms expire 1896.
PROF. WILLIAM A. ANTHONY,
PROF. FRANCIS B. CROCKER,
JAMES HAMBLET.

MANAGERS:

Terms expire 1895.
CHARLES WIRT,
ANGUS S. HIBBARD,
DR. MICHAEL I. PUPIN,
CHARLES P. STEINMETZ.

Terms expire 1896.
PROF. HARRIS J. RYAN,
CHARLES HEWITT
J. J. CARTY,
WILLIAM J. HAMMER.

Terms expire 1897.
A. E. KENNELLY,
WILLIAM D. WEAVER,
CHARLES S. BRADLEY,
W. B. VANSIZE.

Terms expire 1895.

TREASURER:
GEORGE M. PHELPS,
202 Broadway, New York.

SECRETARY:
RALPH W. POPE
26 Cortlandt St. New York.

Board of Examiners:
GEORGE A. HAMILTON, Chairman.
E. T. BIRDSALL,
J. STANFORD BROWN.
C. O. MAILLOUX,
EDWARD P. THOMPSON.

Standing Committees appointed by direction of Council:

Committee on Papers, Meetings, and Editing.

FRANCIS B. CROCKER, Chairman.
J. J. CARTY, JOHN W HOWELL, DR. M. I. PUPIN, GEO. M. PHELPS.
PROF. H. J. RYAN, DR. SCHUYLER S. WHEELER.

Sub-Committee on Editing.
GEORGE A. HAMILTON, Chairman.
C. O MAILLOUX,
FRANKLIN L. POPE.

Sub-Committee on Papers and Meetings.
T. COMMERFORD MARTIN, Chairman.
HORATIO A. FOSTER,
H. WARD LEONARD,
WM. MAVER, JR.,
HERBERT LAWS WEBB.

Library Committee.

J. STANFORD BROWN, Chairman.
GEORGES D'INFREVILLE, GEORGE H. STOCKBRIDGE.

Committee on Finance, Building and Permanent Quarters.

GEORGE M. PHELPS, Chairman.
GEORGE A. HAMILTON, DR. SCHUYLER S. WHEELER, THOMAS A. EDISON,
FRANKLIN L. POPE, FRANCIS R. UPTON, T. COMMERFORD MARTIN,
DR. F. BENEDICT HERZOG.

Committee on Units and Standards.

A. E. KENNELLY, Chairman. GEO. A. HAMILTON, DR WM. E. GEYER,
FRANCIS B. CROCKER. WILLIAM D. WEAVER.

Committee on Membership etc.,

RALPH W. POPE, Chairman
THOMAS D. LOCKWOOD, Local Secretary, Boston, Mass.,
DR. LOUIS DUNCAN, " " Baltimore, Md.,
CARL HERING, " " Philadelphia, Pa.,
PROF. EDWARD L. NICHOLS, " " Ithaca, N. Y.,
JOSEPH WETZLER, R. N. BAYLIS. H. A. FOSTER, New York City.

BION J. ARNOLD, Local Honorary Secretary,
574-576 The Rookery, Chicago Ill. Telephone, Main 2139.

Frank H. Spragues

CONTENTS.

FRONTISPIECE.—Portrait of Frank J. Sprague, Eighth President of the Institute.—1892–93.

REGULAR MEETING, January 17, 1894. PAGE.

Practical Properties of Polyphase Apparatus.—(Illustrated.) By Louis Bell, of Chicago. Discussion by William Stanley, O. T. Crosby, Chas. P. Steinmetz, C. O. Mailloux, Fred'k Darlington, M. I. Pupin 1

Report of Committee on Units and Standards.—Discussion by Townsend Wolcott, C. O. Mailloux, Chas. P. Steinmetz, A. E. Kennelly and C. S. Bradley 48

Report of Committee on Revision of Rules 52

REGULAR MEETING, February 21, 1894.

Concerning a Change of Policy in the Administration of the Patent Office.—By Philip Mauro, of Washington, D. C. Discussion by W. B. Vansize, Edward P. Thompson, Theo. J. W. Olan, M. N. Forney, Joseph Sachs, E. J. Houston and Almon Robinson 56

How Shall We Operate an Electric Railway Extending One Hundred Miles from the Power Station?—(Illustrated.) By H. Ward Leonard, of New York City. Discussion by Chas. G. Curtis, C. O. Mailloux, Nelson W. Perry, George Hill, Chas. Hewitt, A. E. Kennelly, Wm. Elmer, Jr., C. J. Field, C. J. H. Woodbury, Joseph Sachs, R. N. Baylis and Geo. P. Low 76

Local Meetings at Chicago 108

Revision of Election Rules 109

Incompleted Work of the International Electrical Congress of 1893 111

Sub-Committees on Incompleted Congress Work 113

Communication by Theo. J. W. Olan in Discussion of Mr. Mauro's Paper 114

REGULAR MEETING, March 21, 1894.

Report of Committee on Units and Standards.—Discussion by A. E. Kennelly, Townsend Wolcott, F. B. Crocker, C. S. Bradley, Wm. E. Geyer, E. J. Houston, Cary T. Hutchinson, M. I. Pupin and F. S. Holmes 124

On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp.—By Prof. Wm. A. Anthony, of New York. Discussion by Wm. Lispenard Robb, Elihu Thomson, Edward P. Thompson, John W. Howell, W. J. Hammer, Cary T. Hutchinson, S. E. Doane, Theo. J. W. Olan, E. A. Colby, L. K. Böhm, Otto A. Moses, Wm. A. Anthony, D. McFarlan Moore, R. A. Fessenden and Chas. J. Reed 133

Discussion in Chicago by W. M. Stine, B. J. Arnold, L. Gutmann and Carl Kammeyer 181

REGULAR MEETING, April 18, 1894.

Report of Committee on Units and Stardards —Discussion by Townsend Wolcott, E. J. Houston, F. B. Crocker, G. A. Hamilton, W. E. Geyer, A. E. Kennelly, Geo. M. Phelps and I. H. Farnham... 188
Destructive Effects of Electrical Currents on Subterranean Metal Pipes.—(Illustrated.) By Isaiah H. Farnham, of Boston, Mass. Discussion by Geo. W Plympton, Townsend Wolcott, A. E. Kennelly, T. D. Lockwood, I. H. Farnham, E. J. Houston, Leonard Waldo, Chas. E. Emery, Elihu Thomson, Hermann Lemp, Jr. 191
Discussion at Chicago, April 25, 1894, by B. J. Arnold, A. T. Welles, Paul Biefeld, Fred. D. Silber, C. G. Armstrong, A. V. Abbott..... 230

ANNUAL MEETING, Philadelphia, May 15, 1894.

Report of Council..... 247
Secretary's Report..... 250
Treasurer's Report..... 251
Report of Committee on Units and Standards.—Discussion by Chas. Hewitt, C. P. Steinmetz, Fred'k Bedell, A. E. Kennelly, Jas. Hamblet and Carl Hering..... 251
Associate Members Elected and Transferred..... 261
Expenses of Chicago Meetings.—Discussion by Chas Hewitt, Geo. M. Phelps, Jas. Hamblet, E. J. Houston, W. J. Hammer, R. W. Pope, C. P. Steinmetz, A. E. Kennelly and W. A. Anthony. .. 263
Report of Committee on Revision of Rules.—Discussion by Geo. M. Phelps, R. W. Pope, E. J. Houston and F. R. Upton..... 270
Teller's Report..... 273
A Review of the Progress of the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—(Illustrated.) Inaugural Address by Edwin J. Houston, President..... 275

GENERAL MEETING, at Philadelphia, May 16, 17 and 18, 1894.

On the Subdivision and Distribution of Artificial Sources of Illumination.—(Illustrated.) By Wm. A. Anthony, of New York. Discussion by Nelson W. Perry, E. J. Houston A. E. Kennelly, C. P. Steinmetz, Clayton W. Pike, R. W. Pope, F. R. Upton, R. O. Heinrich and W. J. Hammer..... 285
Some Storage Battery Phenomena.—(Illustrated.) By W. W. Griscom, of Philadelphia. Discussion by Louis Duncan, Townsend Wolcott. Communications by Sir David Salomons and Fred'k Reckenzaun..... 302
Discriminating Lightning Arresters, and Recent Progress in Means for Protection against Lightning.—(Illustrated.) By Alex. Jay Wurts, of Pittsburg, Pa Discussion in Philadelphia by Jos. Sachs, A. J. Wurts, Wm. Stanley, Chas. Hewitt, W. E. Harrington, A. E. Kennelly, C. P. Steinmetz and W. J. Jenks 337
Discussion in Chicago, May 23, 1894, by B. J. Arnold, A. V. Abbott, L. Gutmann, C. C. Haskins, Geo. M. Mayer. Communication by Carl K. MacFadden 396
Unipolar Dynamos for Electric Light and Power.—(Illustrated.) By F. B. Crocker and C. H. Parmly, of New York. Discussion in Philadelphia by Carl Hering, F. B. Crocker, Wm. Stanley, A. E. Kennelly and C. P. Steinmetz 406
Alternating Currents and Fuses.—(Illustrated.) By D. C. Jackson, of Madison, Wis., and R. J. Ochsner. Discussion in Philadelphia by Leonard Waldo and J. P. Jackson. Communication by Sir David Salomons..... 430

Test of Closed Coil Arc Dynamo.—(Illustrated.) By R. B. Owens, of Lincoln, Neb., and C. A. Skinner. Discussion by C. N. Black and C. P. Steinmetz 441
Relative Advantages of Toothed and Smooth Core Armatures.—By Alton D. Adams, of Boston, Mass. Discussion by A. E. Wiener, C. P. Steinmetz, Gano S. Dunn, Wm. Stanley, C. N. Black, A. E. Kennelly and Oberlin Smith 465
Standardizing Electrical Measuring Instruments.—(Illustrated.) By Elmer G. Willyoung, of Philadelphia. Discussion by R. O. Heinrich 476
An Optical Phase Indicator and Synchronizer.—(Illustrated.) By Geo. S. Moler and Frederick Bedell 502
A Reliable Method of Recording Variable Current Curves.—(Illustrated.) By Albert C. Crehore, Hanover, N. H. Discussion by C. P. Steinmetz and Wm. A. Anthony 507
Resonance Analysis of Alternating and Polyphase Currents.—(Illustrated.) By M. I. Pupin, of New York City. Discussion by W. A. Anthony, C. P. Steinmetz and A. E. Kennelly 523
Some Facts about Polyphase Motors.—(Illustrated.) By Louis Bell, of Chicago Discussion by Carl Hering and C. P. Steinmetz ... 559
On the Law of Hysteresis (Part III.) and the Theory of Ferric Inductances.—(Illustrated.) By Chas. P. Steinmetz, Schenectady, N. Y. Discussion by Fred'k Bedell, Chas. P. Steinmetz, M. I. Pupin, A. E. Kennelly and W. A. Anthony 570
Experiments on Two-Phase Motors.—(Illustrated.) By Louis Duncan, S. H. Brown, W. P. Anderson and S. Q. Hayes. Discussion by Chas P. Steinmetz, C. F. Scott, W. A. Anthony and M. I. Pupin 617
Resolutions Acknowledging Courtesies 637
Smooth and Toothed Core Armatures.—(Reply to discussion, by A. D. Adams, p 465) 637
Memorial to the United States Congress 639
Reactance.—(Illustrated.) By C. P. Steinmetz and Fred'k Bedell.... 640
Communication by H. J. Ryan 648
Associate Members Elected and Transferred 650

REGULAR MEETING, September 19, 1894.

A Study of the Residual Charges of Condensers, and their Dependence upon Temperature.—(Illustrated.) By Fred'k Bedell and Carl Kinsley 656
The Electric Brake in Practice.—(Illustrated.) By Elmer A. Sperry, of Cleveland. Discussion in New York by Jos. Wetzler, C. S. Bradley, E. A. Sperry, W. J. Hammer, R. W. Pope, Jos. Sachs, Max Osterberg, Robt. McA. Lloyd, Frankland Jannus and E. A. Merrill. Communications by E. A. Merrill, W. E. Harrington and Jos. Sachs 682
Discussion in Chicago by Carl Kammeyer, L. H. Rogers, Mr. Grier, B. J. Arnold, Edw. Caldwell, W. M. Stine, E. F. Norton and Walter Lobach 720

REGULAR MEETING, October 17, 1894.

Theory of Two- and Three-Phase Motors.—(Illustrated.) By Lieut. Sam'l Reber, of Fort Riley, Kan. Discussion in New York by M. I. Pupin, C. P. Steinmetz and A. E. Kennelly 731
Discussion in Chicago by W. M. Stine and H. J. Sage 761
Theory of the Synchronous Motor.—(Illustrated.) By Chas. P. Steinmetz of Schenectady, N. Y. Discussion in New York by A. E. Kennelly, M. I. Pupin and Chas. P. Steinmetz 763
Discussion in Chicago by M. A. Edson 783
Willyoung on Measuring Instruments.—Discussion in Chicago by J. G. Wray, S. A. Rhodes and W. M. Stine 783

REGULAR MEETING, November 21, 1894.

Suggestions for an Index of Engineering Literature.—By Geo. D. Shepardson, of Minneapolis. Discussion in New York by T. C. Martin, J. Stanford Brown, W. E. Goldsborough (communicated), Max Osterberg (communicated), Carl Hering (communicated), F. B. Crocker, Edward Caldwell and R. W. Pope. Communication by Wm. S Aldrich 789
Discussion in Chicago by Fred. De Land, W. M. Stine and L. L. Summers. 821
Report of Committee on Units and Standards 827

REGULAR MEETING, December 19, 1894.

On the Production of Rotary Magnetic Fields by a Single Alternating Current.—(Illustrated.) By Ludwig Gutmann, of Chicago. Discussion in New York by M. I. Pupin, Townsend Wolcott, A. E. Kennelly and Sam'l Sheldon 832
Discussion in Chicago by Carl K. MacFadden, L. L. Summers L. Gutmann..... 851
Communication by Elihu Thomson 853
Rail Bonding and its Bearing on Electrolytic Corrosion.—(Illustrated.) By Geo. P. Low. A communication in discussion of Mr. Farnham's paper..... 857

OBITUARY.

Franz Schulze-Berge..... 873
Alexander Henry Bauer..... 874
Rudolf Eickemeyer 876

CATALOGUE OF MEMBERSHIP,

Revised to March 1st, 1895..... 879

INDEX.

AUTHORS OF PAPERS AND PARTICIPANTS IN DISCUSSIONS.

Abbott, A. V.....242, 396
Adams, A. D.....465, 637
Aldrich, W. S.....816
Anderson, W. P.....617
Anthony, Wm. A.....132, 133, 174, 177, 268, 285, 292, 294, 295, 296, 521, 551, 610, 633
Armstrong, C. G.....240
Arnold, B. J.....230, 396, 721, 722, 723, 724
Baylis, R. N.....104
Bedell, Frederick.....258, 502, 609, 611, 614, 640, 656
Bell, Louis.....3, 32, 42, 46, 559
Biefeld, Paul.....236
Binney, Harold.....557
Black, C. N.....460, 463, 464, 474
Böhm, L. K.....168
Bradley, C. S.....52, 128, 129, 710, 713, 716
Brown, J. Stanford.....796
Brown, S. H.....617
Burnett, Douglas.....108, 110
Caldwell, Edward.....723, 724, 803
Colby, E. A.....165
Crehore, A. C.....507
Crocker, F. B.....126, 130, 189, 190, 260, 261, 406, 424, 429, 355, 681, 710, 717, 801, 803
Crosby, O. T.....39
Curtis, C. G.....84, 85, 86, 87, 88, 92, 93, 94, 95
Darlington, F.....43, 44, 45
De Land, Fred.....821
Doane, S. E.....162
Duncan, Louis.....320, 617
Dunn, G. S.....472, 473
Edson, M. A.....783
Elmer, Wm., Jr.....100
Emery, C. E.....226
Farnham, I. H.....190, 191, 220, 222, 224, 244
Fessenden, R. A.....178
Field, C. J.....101
Forney, M. N.....72
Geyer, Wm. E.....128, 131, 189
Goldsborough, W. E.....798
Grier, Mr.....720, 722, 723, 724, 725, 726
Griscom, W. W.....302, 321, 323, 330
Gutmann, L.....398, 832, 852, 853, 854
Hamblet, James.....259, 264, 267

Hamilton, George A....189
Hammer, W. J....161, 162, 264, 265, 270, 300, 558, 711
Harrington, W. E....718
Haskins, C. C....401
Hayes, S. O....617
Heinrich, R. O....296, 492
Hering, Carl....261, 268, 423, 569, 800
Hewitt, Charles....96, 98, 100, 257, 261, 263, 264, 381, 382, 383
Hill, George....95, 98
Holmes, F. S....132
Houston, E. J....32, 43, 49, 52, 54, 55, 72, 73, 75, 102, 104, 105, 107, 108, 109, 110, 125, 129, 132, 150, 151, 161, 162, 176, 188, 189, 190, 214, 223, 246, 251, 257, 259, 260, 261, 263, 264, 268, 269, 270, 271, 272, 274, 275, 292, 295, 296, 300, 301, 429, 464, 551, 557, 558, 569, 637, 796, 812, 831, 848, 851
Howell, J. W....155, 175
Hutchinson, Cary T....129, 130, 132, 161
Jackson, D. C....184, 430
Jackson, J. P....440
Jannus, F....714, 715
Jenks, W. J....392
Kammeyer, C....720, 721, 723
Kennelly, A. E....50, 55, 98, 125, 126, 130, 132, 174, 189, 216, 258, 260, 268, 292, 383, 387, 393, 425, 474, 555, 610, 760, 777, 850
Kinsley, Carl....656
Lemp, H....228
Leonard, H. Ward....75, 76, 84, 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 97, 98, 100, 105, 108
Lloyd, R. McA....713
Lobach, W....726
Lockwood, T. D....221
Low, G. P....107, 857
MacFadden, C. K....404, 851, 852
Mailloux, C. O....43, 49, 51, 52, 88, 99, 100
Martin, T. C....796, 803
Mauro, P....55, 56, 114
Mayer, G. M....402
Merrill, E. A....715, 716, 717
Moler, G. S....502
Moore, D. McF....177
Moses, O. A....170
Norton, E. F....726
Ochsner, R. J....430
Olan, T. J. W....71, 114, 163, 170
Osterberg, M....712, 799
Owens, R. B....441
Parks, C. W....818
Parmly, C. H....406
Perry, N. W....89, 91, 92, 292
Plympton, G. W....214, 222
Phelps, G. M....108, 109, 110, 189, 260, 263, 264, 265, 267, 269, 270, 271
Pike, C. W....293
Pope, R. W....52, 109, 110, 188, 261, 266, 271, 295, 711, 809
Pupin, M. I....46, 130, 151, 523, 555, 557, 611, 614, 636, 748, 753, 754, 779, 781, 782, 846, 849, 850
Reber, Samuel....731
Reckenzaun, F....325
Reed, C. J....179
Rhodes, S. A....784
Robb, W. L....150
Robinson, Almon....74
Rodman, S....783

Rogers, L. H.....720, 721, 722, 723, 724, 725, 726, 727
Ryan, H. J.....648
Sachs, J.....73, 103, 378, 379, 388, 712, 714, 716, 717, 719
Sage, H. J.....761
Salomons, Sir D.....324, 440
Scott, C. F.....632, 633
Sheldon, S.....850
Shepardson, G. D.....789
Silber, F. D.....236
Skinner, C. A.....441
Smith, Oberlin.....474
Sperry, E. A.....681, 682, 710, 711, 712, 713, 714, 715, 716, 717, 718, 720
Stanley, W.....32, 43, 379, 380, 425, 473
Steinmetz, C. P.....40, 45, 46, 47, 49, 257, 259, 260, 268, 293, 387, 395, 426, 460, 463, 464, 470, 473, 474, 521, 551, 557, 569, 570, 609, 610, 611, 212, 614, 632, 635, 640, 751, 753, 754, 763, 781, 782
Stewart, Mayor of Philadelphia.....246
Stine, W. M.....181, 236, 720, 721, 724, 726, 727, 728, 761, 784, 822
Summers, L. L.....821, 825, 851, 852, 853
Thompson, E. P.....70, 154
Thomson, Elihu.....151, 227, 853
Trautwine, J. C., Jr.....246
Upton, F. R.....108, 272, 295
Vansize, W. B.....68
Waldo, Leonard.....225, 439
Welles, A. T.....234, 236
Wetzler, J.....710
Wiener, A. E.....469
Willyoung, E. G.....476
Wolcott, T.....49, 125, 128, 188, 216, 322, 849, 850
Woodbury, C. J. H.....102
Wray, J. G.....783
Wurts, A. J.....337, 378, 379, 380, 381, 382, 383, 386, 387, 392, 394

TITLES OF PAPERS, TOPICS DISCUSSED, ETC.

Administration of the Patent Office, Concerning a Change of Policy in the (*Philip Mauro*).....56, 114
A. I. E. E., Review of the Progress of the (Inaugural Address, *President Houston*).....275
Alternating and Polyphase Currents, Resonance Analysis of (*M. I. Pupin*).....523
Alternating Current, On the Production of Rotary Magnetic Fields by a Single (*L. Gutmann*).....332
Alternating Currents and Fuses (*D. C. Jackson* and *R. J. Ochsner*).....430
Apparatus, Practical Properties of Polyphase (*Louis Bell*).....3
Arc Dynamo, Test of a Closed Coil (*R. B. Owens* and *C. A. Skinner*).....441
Artificial Sources of Illumination, On the Subdivision and Distribution of (*W. A. Anthony*).....285

Balance Sheet, Secretary's.....250
Bauer, Alexander Henry (Obituary).....874
Brake in Practice, The Electric (*Elmer A. Sperry*).....682
Building Fund.....251

Catalogue of Members.....879
Change of Policy in the Administration of the Patent Office, Concerning a (*Philip Mauro*).....56, 114
Chicago, Local Meetings at.....107, 263

Closed Coil Arc Dynamo, Test of a (*R. B. Owens* and *C. A. Skinner*) .441
Committee on Installations, Report of.....558
Committee on Resolutions.....637
Committee on Revision of Rules, Report of.....52, 270
Committee on Units and Standards, Report of.....48, 124, 188, 252, 837
Concerning a Change of Policy in the Administration of the Patent Office (*Philip Mauro*).....56, 114
Condensers and their Dependence upon Temperature. A Study of the Residual Charges of (*Frederick Bedell* and *Carl Kinsley*).....656
Congress, Memorial to, Prepared and Submitted by the Committee on Units and Standards.....639
Congress of 1893. Incompleted Work of the International Electrical.... 111
Council. Report of the.....247
Current Curves, A Reliable Method of Recording Variable (*A. C. Crehore*).....507

Destructive Effects of Electrical Currents on Subterranean Metal Pipes (*I. H. Farnham*).....191, 857
Discriminating Lightning Arresters, and Recent Progress in Means for Protection Against Lightning (*A. J. Wurts*).....337
Dynamo, Test of Closed Coil Arc (*R. B. Owens* and *C. A. Skinner*)....441
Dynamos, Unipolar (*F. B. Crocker* and *C. H. Parmly*).....406

Effect of Electrical Currents on Subterranean Metal Pipes, Destructive (*I. H. Farnham*).....191, 857
Effect of Heavy Gases in the Chamber of an Incandescent Lamp, On the (*W. A. Anthony*).....133
Eickemeyer, Rudolf (Obituary).....876
Election of Officers, Vote for.....273
Electrical Congress of 1893, Incompleted Work of the International....111
Electrical Currents on Subterranean Metal Pipes, Destructive Effects of (*I. H. Farnham*).....191, 857
Electrical Measuring Instruments, Standardizing (*E. G. Willyoung*) 476, 788
Electric Brake in Practice, The (*E. A. Sperry*).....682
Electric Railway Extending One Hundred Miles from the Power Station, How Shall We Operate an (*H. Ward Leonard*).....76
Electrolytic Corrosion, Rail Bonding and its Bearing on (*Geo. P. Low*)..857
Engineering Literature, Suggestions for an Index of (*Geo. D. Shepardson*).....789
Experiments on Two-Phase Motors (*L. Duncan, S. H. Brown, W. P. Anderson* and *S. Q. Hayes*).....617
Expenses of Local Meetings at Chicago.....263
Expenses of the Institute, Itemized Statement of Receipts and.....250

Ferric Inductances, On the Law of Hysteresis (III.) and the Theory of (*C. P. Steinmetz*).....570
Fund, Building.....251
Fuses, Alternating Currents and (*D. C. Jackson* and *R. J. Ochsner*)....430

Heavy Gases in the Chamber of an Incandescent Lamp, On the Effect of (*W. A. Anthony*).....133
How Shall We Operate an Electric Railway Extending One Hundred Miles from the Power Station? (*H. Ward Leonard*).....76
Hysteresis (Part III.) and the Theory of Ferric Inductances, On the Law of (*C. P. Steinmetz*).....570

Incandescent Lamps, On the Effect of Heavy Gases in the Chamber of an (*W. A. Anthony*).....133
Incompleted Work of the International Electrical Congress of 1893.....111
Index of Engineering Literature, Suggestions for an (*Geo. D. Shepardson*).....789
Instruments, Standardizing, Electrical Measuring (*E. G. Willyoung*) 476, 788
Itemized Statement of Receipts and Expenditures of the Institute.....250

Lightning Arresters, Discriminating (*A. J. Wurts*).....337
Literature, Suggestions for an Index of Engineering (*Geo. D. Shepardson*).....789
Local Meetings at Chicago.....107, 263

Memorial to the United States Congress, Prepared and Submitted by the Committee on Units and Standards.....639
Motors, Experiments on Two-Phase (*L. Duncan, S. H. Brown, W. P. Anderson* and *S. Q. Hayes*).....617
Motors, Some Facts about Polyphase (*Louis Bell*).....559
Motors, Theory of Two- and Three-Phase (*Samuel Reber*).....731
Motor, Theory of the Synchronous (*C. P. Steinmetz*).....763

Obituary: Franz Schulze-Berge.....878
Alexander Henry Bauer.....874
Rudolf Eickemeyer.....876
One Hundred Miles from the Power Station, How Shall We Operate an Electric Railway Extending (*H. Ward Leonard*).....76
Optical Phase Indicator and Synchronizer, An (*Geo. S. Moler* and *Frederick Bedell*).....502

Patent Office; Concerning a Change of Policy in the Administration of the (*Philip Mauro*).....56, 114
Phase Indicator and Synchronizer, An Optical (*Geo. S. Moler* and *Frederick Bedell*).....502
Polyphase Apparatus, Practical Properties of (*Louis Bell*).....3
Polyphase Currents, Resonance Analysis of Alternating and (*M. I. Pupin*).....523
Polyphase Motors, Some Facts about (*Louis Bell*).....559
Practical Properties of Polyphase Apparatus (*Louis Bell*).....3

Rail Bonding, and its Bearing on Electrolytic Corrosion (*Geo. P. Low*).....857
Reactance (*C. P. Steinmetz* and *Frederick Bedell*).....640
Receipts and Expenses of the Institute, Itemized Statement.....250
Recent Progress in Means for Protection Against Lightning (*A. J. Wurts*).....337
Recording Variable Current Curves, A Reliable Method of (*A. C. Crehore*).....507
Relative Advantages of Toothed and Smooth Core Armatures (*Alton D. Adams*).....465, 637
Report of Committee on Installations.....558
Report of Committee on Revision of Rules.....52, 270
Report of Committee on Units and Standards.....48, 124, 188, 252, 827
Report of the Council.....247
Report, Teller's.....273
Report, Treasurer's.....251
Residual Charges of Condensers and their Dependence upon Temperature, A Study of the (*Frederick Bedell* and *Carl Kinsley*).....656
Resolutions Acknowledging Courtesies.....637
Resonance Analysis of Alternating and Polyphase Currents (*M. I. Pupin*).....523
Review of the Progress of the American Institute of Electrical Engineers (*President Houston*). Inaugural Address.....275
Revision of Election Rule.....52, 108, 270
Revision of Rules, Report of Committee on.....52, 270
Rotary Magnetic Fields by a Single Alternating Current, On the Production of (*L. Gutmann*).....832

Schulze-Berge, Franz, Obituary.....878
Secretary's Balance Sheet.....250
Single Alternating Current, On the Production of Rotary Magnetic Fields by a (*L. Gutmann*).....832
Smooth Core Armatures, Relative Advantages of Toothed and (*Alton D. Adams*).....465, 637

Some Facts about Polyphase Motors (*Louis Bell*).....559
Some Storage Battery Phenomena (*W. W. Griscom*).....802
Standardizing Electrical Measuring Instruments (*E. G. Willyoung*) 476, 783
Statement of Receipts and Expenses of the Institute, Itemized.....250
Storage Battery Phenomena, Some (*W. W. Griscom*).....802
Sub-Committees on Incompleted Congress Work.....113
Subdivision and Distribution of Artificial Sources of Illumination, On the (*W. A. Anthony*).....285
Subterranean Metal Pipes, Destructive Effect of Electric Currents on (*I. H. Farnham*).....191, 857
Synchronous Motor, Theory of the (*C. P. Steinmetz*).....763

Teller's Report.....273
Test of a Closed Coil Arc Dynamo (*R. B. Owens* and *C. A. Skinner*)..441
Theory of the Synchronous Motor (*C. P. Steinmetz*).....763
Theory of Two- and Three-Phase Motors (*S. Reber*).....731
Toothed and Smooth Core Armatures, Relative Advantages of (*Alton D. Adams*).....465, 637
Treasurer's Report.....251
Two- and Three-Phase Motors, Theory of (*S. Reber*).....731
Two-Phase Motors, Experiments on (*L. Duncan, S. H. Brown, W. P. Anderson* and *S. Q. Hayes*).....617

Unipolar Dynamos for Electric Light and Power (*F. B. Crocker* and *C. H. Parmly*).....406
Units and Standards, Report of Committee on.....48, 124, 188, 252, 827

Vote at Annual Election.....273

NOTICE.

The INSTITUTE as a body is not responsible either for the statements made, or for the opinions expressed, in the following pages.

McILROY & EMMET, Steam Printers, 36 Cortlandt St., New York.